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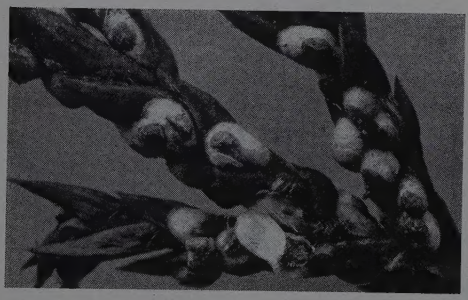
by John C. Schread



THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

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APHIDS AND SCALE INSECTS ON ORNAMENTALS

John C. Schread

Almost all plants that live, cultivated or wild, are hosts to one or more species of aphids. Hence, it is not surprising that ornamentals have their share of the pests. Aphids, like scale insects, obtain their food by sucking the juice from plant tissue. Certain species feed on foliage, others on twigs and branches, flowers or fruit, and some even on roots. There are species that live on several distinct hosts, spending a part of their seasonal development on one plant and the remainder on another. Some of these are root feeders at one time and foliage feeders at another, changing from host to host as the seasons change.

For the most part, scale insects complete their life cycle on a single host. There are, however, certain species that appear to be equally well at home on a variety of plants.

Adequate control of aphids and scale insects has been a problem to home owners and plant breeders for years. Earlier methods of treatment frequently appeared to be inadequate, perhaps because they were not made at the right time of year, or were applied to the wrong life stage of the insect. Sometimes treatments were not made frequently enough. Some pests have a number of generations a year, making several spray applications a season necessary.

Because of an increasing realization by the public of the need for information regarding control of these insect pests, combined with the fact that a greater number of insecticides are now obtainable for the purpose, this bulletin has been prepared to summarize results of experiments to control several species of aphids and scale insects on ornamentals.

The four species of aphids found on hawthorn are: *Aphis pomi, Anuraphis rosens, Rhopalosiphum prunifoliae* and *Amphorophora crataegi* (Monell). The black bean aphid, *Aphis fabae* (Kalt), and *Anuraphis viburnicola* Gillette are found on viburnum. Tests were also made on the pine bark aphid, *Pineus strobi* (Htg.), a species of aphid on snapdragon, *Myzus persicae* Sal., the European elm scale, *Gossyparia spuria* (Mod.), the juniper scale, *Diaspis carueli* Targ, a new species of scale on hemlock, *Aspidiotus* sp., and the soft brown scale, *Coccus hesperidum* L., on Boston ivy, camellia and avocado.

HAWTHORN APHIDS

Aphis pomi, Anuraphis roseus, Rhopalosiphum prunifoliae and *Amphorophora crataegi* are frequently serious pests of hawthorns. The species *Anuraphis roseus* causes considerable curling of leaves during the growing season. In addition, the branches and foliage become covered with sooty fungus which grows in the honeydew secreted by the insects. When severe infestation occurs, leaves drop prematurely. Obviously these conditions may cause plants to become unsightly during the summer months. For the most part, however, affected trees and shrubs do not suffer seriously enough to result in dieback of portions or all of a plant.

Aphids occur in multiple generations from spring through early autumn. With the exception of the eggs, all stages of the insects are present continuously during the summer months. Because of this the generations cannot be easily separated. In 1954 over-wintering eggs were first seen hatching on April 2. This may vary with the season, but in most years hatching takes place in late March or early April.

Control Experiments

Experiments in control of hawthorn aphids were carried on during the growing seasons of 1953 and 1954. Pauls Scarlet variety of English hawthorn *Crataegus oxyacantha* (var. *Paulii*) was used for the insecticide tests.

TABLE 1. APHID CONTROL ON HAWTHORN, 1953

Treatment[1] and Dilution		Av. No. Live Aphids per 10 Leaves		
		No. Weeks After Treatment		
		3	6	9
Isolan 25%	1-1600	.03	1.3	9.3
	1-800	.07	.03	0
	1-400	.03	0	0
Malathion 50%	1-1600	0	.03	.1
	1-800	0	0	0
	1-400	.13	3.5	0
BHC 13.75%	1-1600	5.7	12.9	0
	1-800	.03	6.9	17.33
	1-400	.03	0	0
Untreated		33.7	14.9	60

[1] All treatments applied July 8; a second application of formulations containing malathion and BHC was made August 21.

The trees were six to seven years old and averaged ten feet in height. During the first season they were growing in a nursery but were transplanted in the early part of the second year to city streets.

On July 8, 1953, aphid-infested trees were sprayed with Isolan 25 per cent, malathion 50 per cent and BHC 13.75 per cent emulsions in dosage series of 1 to 400, 1 to 800, and 1 to 1600. The trees were randomized in a block of 150 and replicated twice. An additional spreading and sticking agent[1] was used to increase the adhesiveness and perhaps prolong the toxic action of the insecticides. Because of the increase in aphid population, the malathion and BHC treated trees were resprayed on August 21. The trees treated with Isolan were not resprayed. The amount of spray material used per tree averaged 1.5 quarts. A 12-quart wheelbarrow mist-blower was used to make the treatments.

Data on control were obtained by averaging the number of aphids on 10 leaves taken at random from each treated tree at weekly intervals. Data are tabulated, at three-week intervals only (Table 1).

[1] Triton B-1956.

Each material gave good control of aphids at all dilutions. Isolan appeared to have the longest residual action. This was most noticeable at the highest concentrations. Malathion compared favorably with Isolan in over-all long-time effectiveness. BHC, however, seemed to be less efficient than the other insecticides in preventing reestablishment of aphids. This was more obvious at the lowest dilutions.

The 1954 experiment was designed to ascertain the most effective time to spray hawthorn trees in the spring to prevent serious curling of the foliage and accumulation of sooty fungus. Consequently treatments were applied on four occasions during April. Each tree was sprayed only once during the month. There were not enough trees on the city street where the spraying was done to permit replication.

TABLE 2. APHID CONTROL ON HAWTHORN—EXAMINED JUNE 7, 1954

Treatment & Dilution		Av. No. Live Aphids per Three 3" Twigs		
		April 6[1]	April 20	April 26[2]
Isolan	1-400	17	17	45
	1-200	41	13	32
12009	1-400	53	16	8
	1-200	34	18	37
BHC	1-400	34	43	80
	1-200	17	35	9
Malathion	1-400	39	17	6
	1-200	41	21	17

[1] Dates given are day treatment was made.
[2] Dilutions for this date were 1-800 and 1-1600.

In addition to Isolan, malathion and BHC, a systemic compound currently known as experimental dithiophosphate insecticide 12009,[1] 50 per cent emulsion, was added to the list. Treatments were made April 6, 12, 20 and 26. The insecticides were used in dosage series of 1 to 200 and 1 to 400 during the first three series of treatments and at 1 to 800 and 1 to 1600 in the fourth series. Reduction in concentrations was intended to prevent possible foliage injury by the materials.

Examinations made on May 7 showed that all of the trees sprayed between April 6 and 26 were free from aphid infestation. No curled leaves were found on the trees. An examination of an untreated tree revealed numerous curled leaves, ten of which contained an average of 3.8 live aphids with a maximum of 11 and a minimum of 1. The leaves at this time were from ⅓ to ½ mature size.

By June 1 aphid colonies were appearing on the sprayed trees. On June 7 counts were made on all of the leaves on three 3-inch terminal twigs taken at random from each treatment (Table 2).

[1] The three systemic materials used in the experiments reported in this bulletin were obtained from the American Cyanamid Company. They are:
12008-*0,0* diethyl *S*-isopropylmercaptomethyl dithiophosphate
12009-*0,0* diethyl *S*-*n*-propylmercaptomethyl dithiophosphate
12013-*0,0* diisopropyl *S*-isopropylmercaptomethyl dithiophosphate

In view of the recurrence of infestation in all of the sprayed trees in late May and early June (Table 2), they were resprayed on June 9 using the insecticides in dosage series of 1 to 400 and 1 to 800. The treatments were randomized and replicated three times. Data on control appear in Table 3.

Because of the obvious persistence of infestation on the fast growing twigs during June and July (Table 3), the trees were resprayed on July 19. BHC was not used in these tests (Table 4).

TABLE 3. APHID CONTROL ON HAWTHORN—SPRAYED JUNE 9, 1954

Treatment & Dilution		Av. No. Aphids on Six 3"-4" Twigs per Treatment on:					
		June 14		June 28		July 15	
		Dead	Alive	Dead	Alive	Dead	Alive
Isolan	1-800	34	0	0	13	0	12
	1-400	44	0	0	53	0	33
12009	1-800	18	0	10	0	0	0
	1-400	4	0	1	64	0	62
BHC	1-800	2	39	0	102	0	170
	1-400	0	33	0	75	0	239
Malathion	1-800	1	30	0	63	0	183
	1-400	2	25	0	60	0	347
Untreated		0	42	0	40	0	30

TABLE 4. APHID CONTROL ON HAWTHORN—SPRAYED JULY 19, 1954

Treatment & Dilution		Av. No. Aphids July 25 on Three 3"-5" Twigs per Treatment	
		Dead	Alive
Isolan	1-800	215	0
	1-400	103	0
12009	1-800	225	0
	1-400	183	0
Malathion	1-800	91	0
	1-400	483	0
Untreated		24	291

An examination of the preceding tables will show that the control of hawthorn aphids was not permanent with one or several treatments of the insecticides used in the tests. Longest-lasting control was obtained during April and early May with one treatment applied during April. Treatments made after the first week in July were also effective for a substantial length of time. An explanation for this is that the trees were growing slower during early spring and had slowed down with progressive hardening off after early July. Hence, for the most part, only treated foliage was available to aphids during these periods. On the other hand, spray treatments applied from mid-May to early July could not be expected to prevent infestation of rapidly developing terminal leaves unprotected by insecticide residue.

The systemic insecticide 12009 seemed to prevent reinfestation for a longer time than the other materials. This may be due to absorption by the trees. Isolan was slightly better in this respect than BHC and malathion. The insecticides caused no noticeable injury to hawthorn foliage.

VIBURNUM APHIDS

(*Aphis fabae* (Kalt) and *Anuraphis viburnicola* Gill)

There are more than sixty known varieties of viburnum, many of which are native to North America. They occur as shrubs or small trees. All have more or less conspicuous flowers which are white or pinkish in color. Plants belonging to this genus are among the most popular of the flowering deciduous ornamentals grown in the northeastern part of the United States.

Figure 1. Timing of treatment is important in controlling aphids on viburnum. The plant at left was treated with Isolan in early April. Treatment to the middle plant was delayed until late the same month. The plant at the right received no treatment. All plants were photographed on May 21.

Many of the varieties acquire beautiful fall colors. In addition, the characteristic small berry-like fruit serves as food for birds during late autumn and winter.

Despite the large number of varieties growing in the north-temperate climate, only a few are seriously injured by aphids. One which appears to be among the most noticeably affected is the European cranberry bush *Viburnum opulus,* of which the common snowball var. *roseum* (var. *sterili*) occurs over a wide range of distribution. The characteristic injury which develops during the growing season is manifested by curling and stunting of the leaves (Figure 1). This may be serious enough to involve all of the foliage on a plant. Frequently under such conditions the growth of the plant is checked completely.

Because of overlapping aphid generations, it is difficult to separate the broods. In 1954, an examination on March 29 on 8 to 10-inch twigs showed that hatching had not commenced. On April 1 the first live aphids were seen.

Control Experiments

An experiment was designed to determine the right time to spray in April to prevent curling of leaves by *Anuraphis viburnicola*. Sixteen plants varying from 4 to 10 feet in height and 5 to 20 feet in circumference were used for the insecticide tests. Each plant was sprayed only once. Because of the small number of plants available for the purpose, replication and randomization could not be followed.

Isolan was used at 1 to 200 and 1 to 400 in the first three treatments, April 1, 9 and 14. The 1 to 200 dilution was discontinued in the fourth and fifth treatments, April 20 and 26, and the 1 to 400 dilution in the April 26

TABLE 5. RESULTS OF TREATMENTS TO CONTROL VIBURNUM APHID—EXAMINATION MADE MAY 20

Date of Treatment	Bud Development	Treatment & Dilution		No. of Curled Leaves in 20	Aphids	
					Alive	Dead
April 1	Dormant	Isolan	1-200	0	..	..
			1-400	0	..	..
April 9	Buds Swelling	Isolan	1-200	0	..	..
			1-400	0	..	..
April 14	Buds Bursting	Isolan	1-200	0	..	..
			1-400	0	..	..
April 20	Leaves Developing	Isolan	1-400	20	..	..
			1-800	20	..	..
April 26	Leaves Good Size	Isolan	1-800	18	0	26
			1-1600	11	0	11
April 26	Leaves Good Size	BHC	1-800	20	0	6
			1-1600	20	0	1
April 26	Leaves Good Size	Malathion	1-800	15	0	12
			1-1600	8	0	11
Untreated				19	75	0

treatment. They were replaced by a 1 to 800 and a 1 to 1600 concentration in the April 20 and 26 treatments, respectively. The change in dilution levels was intended to prevent possible injury to tender foliage by the insecticides. In addition to Isolan, malathion and BHC were used in the April 20 and 26 treatment series at dilutions of 1 to 800 and 1 to 1600. Large plants received 6 quarts of spray and smaller ones 2 quarts. A 12-quart wheelbarrow mist-blower was used to make the treatments. Control data were obtained by averaging the number of live and dead aphids on 20 leaves taken at random from both sprayed and unsprayed plants (Table 5).

Results indicate that one treatment of Isolan during the first two weeks of April destroyed aphids on viburnum and prevented curling of the leaves. Treatments of malathion, BHC or Isolan during the second half of April did not prevent curling of leaves despite complete kill of aphids. Aphids killed early in the month dropped from the plants or disappeared in some

other way; consequently no record could be had of the numbers present. Aphids killed by the treatments during the second half of the month were found in the curled leaves. The insecticides used in the experiment did not cause any noticeable injury to viburnum foliage.

An examination in early July indicated aphid infestation as negligible on both the treated and untreated viburnums. Consequently, the necessity for an April treatment to control the initial aphid outbreak becomes obvious.

THE PINE BARK APHID

(*Pineus strobi* Htg.)

The pine bark aphid is a small dark species covered with flocculent waxy or cottony-like material (Figure 2). The insects usually work on the trunk

Figure 2. Pine bark aphid on white pine. The aphids are covered with a waxy or cottony-like material which gives this appearance to the tree trunk and limbs.

and undersides of the limbs, and may appear in small clusters at the base of the needles. The white pine[1] is most commonly attacked, although Scotch and Austrian and possibly other species may become infested.

Ornamental trees around the home or in parks and small nursery stock may be seriously injured by the pest. Larger trees growing in forested areas, however, seldom suffer noticeably.[2]

[1] Britton, W. E., 1919, The White Pine Weevil and The Pine Bark Aphid, Conn. Agr. Expt. Sta. Bul. 218.
[2] Craighead, F. C., 1949, Insect Enemies of Eastern Forests, U.S.D.A. Misc. Pub. 657.

There are several broods of pine bark aphid during the growing season. The insect overwinters in Connecticut as a mature wingless female at the base of the needle clusters or on the bark. Eggs begin to appear soon after the first week of April. Hatching, however, does not take place until early May. The first hatch was indicated on May 8 and May 6 in 1953 and 1954, respectively.

In the past, the usual practice in controlling the pest was to spray with a miscible oil or oil emulsion in the spring before the buds open. Later, when the young were hatching, nicotine sulfate and soap solution was used. A variation of this was white-oil emulsion plus nicotine.

Control Experiments

The experiments reported here were carried on for two years. During the first season the insecticide tests were designed to destroy the overwintering females. The second year's work was planned to control the young of the first brood as they hatched.

Seven 20 to 25-foot white pine trees badly infested with pine bark aphid were used in the experiment. Because of the location of the trees on a superhighway, replication of the tests could not be followed conveniently. On April 6, 1953 parathion 25 per cent and malathion 50 per cent emulsions and 40 per cent nicotine sulfate were sprayed on the trees at dilutions of 1 to 100 and 1 to 200. "National Sticker"[1] was added to the parathion and malathion treatments at the rate of 1 to 200 and a soap detergent was used with the nicotine sulfate treatments at the rate of 2 tablespoons per gallon to enhance the spreading and sticking properties of the insecticides. A 12-quart wheelbarrow mist-blower was used to apply the treatments. Only the trunks of the trees to a height of about six feet above the surface of the ground were sprayed. One gallon of spray was used per treatment.

The results of several of these tests were for the most part unsatisfactory. Examination of the sprayed trees in mid-May showed control of the overwintering females on the trees sprayed with parathion and malathion to be negligible, whereas the nicotine sulfate plus soap treatments had given very effective control. There appeared to be only an occasional live female with a few eggs each on the areas of the trees treated with nicotine, whereas there were countless clusters of females with a total of thousands of eggs on the areas of the trees sprayed with parathion and malathion.

The seven trees used in the 1953 experiment were reused in 1954. On May 11, Isolan 25 per cent emulsion and malathion 50 per cent wettable powder were sprayed on one tree per treatment at the rate of 1 to 400 and 1 to 800 of the former and 2 and 4 pounds per 100 gallons of water of the latter. A 500-gallon hydraulic sprayer was used to make the treatments. Each tree was sprayed completely with about 15 gallons of material.

Because of unsatisfactory control with the first treatments, a second application of the insecticides was made on June 18, using Isolan at 1 to 200 and malathion at an 8-pound level. Aphid counts (Table 6) were made of all adults and young on five ¾ to 3-inch terminal twigs taken at random

[1] National Sugar Refining Co.

from twenty 10 to 14-inch branches cut from the periphery of the trees at a height of 5 to 6 feet from the ground.

The results of the 1954 treatments indicated that Isolan and malathion gave good control of pine bark aphid at the highest concentrations only. In this respect malathion was somewhat more efficient than Isolan. In most instances, when live female aphids were found, eggs were also present. The

TABLE 6. PINE BARK APHID CONTROL

Treatment & Dilution	No. Colonies Per 5 Twigs	Aphids		Data Taken
		Alive	Dead	
Isolan 1-200	55	5	145	June 30
1-400	5	30	19	May 18
1-800	5	9	2	May 18
Malathion 2 lbs.	5	22	6	May 18
4 lbs.	5	28	7	May 18
8 lbs.	81	0	290	June 30
Untreated	41	91[1]	0	June 30

[1] Only gravid females were counted. Young were numerous and dispersing.

TABLE 7. PINE BARK APHID REINFESTATION OF TREATED TREES— EXAMINED OCTOBER 18

Treatment & Dilution	No. Aphid Colonies Per Five ¾"-3" Terminal Twigs	Aphids		Eggs
		Dead	Alive	
Isolan 1-200	8	5	15	29
Malathion 8 lbs.	13	1	35	59
Untreated	132	0	31[1]	41[1]

[1] No. of live aphids and eggs per 1 twig containing 10 colonies.

difference between the number of aphid colonies per five twigs on May 18 and June 30 is explained by the fact that during the early season there was an average of only one colony per twig. As the season advanced and the twigs lengthened, the colonies multiplied until there was one or more at the base of nearly every needle cluster.

An examination of the Isolan 1 to 200 and malathion 8-pound treatments was made on October 18 (Table 7).

It can be seen from Table 7 that pine bark aphid reinfestation of trees sprayed with both Isolan and malathion occurred before the close of the growing season when treatments were made in late spring. Obviously, the degree the reinfestation was not so great as in the unsprayed trees. The process of reestablishment of the pest appeared to be slow in the treated trees. The number of live aphids and eggs on the twig samples taken from the untreated trees was great; hence counts were restricted to those present on one out of five twigs (Table 7).

In view of the foregoing results it is to be expected that more than one treatment would be needed to control pine bark aphid completely during a single growing season.

APHID ON SNAPDRAGON

(*Myzus persicae* Sal.)

The green peach aphid, sometimes called the spinach aphid, is a common species, the summer form of which feeds on a wide variety of vegetation, both cultivated and wild.[1] Most all plants grown under glass serve as hosts

Figure 3. The snapdragon plant at left received a soil treatment with a systemic insecticide for control of aphids. The plant at right received no treatment.

to the pest. It is considered to be perhaps the most common greenhouse species. The following are some of the plants it has been reported feeding on: snapdragon, rose, chrysanthemum, cineraria, begonia, carnation, cyclamen, jerusalem-cherry, lily and verbena.

The aphid is light green in color and has clubbed cornicles. The insect feeds in colonies, usually on the terminal shoots (Figure 3). However, if allowed to become numerous, they will feed also on the undersides of the

[1] McDaniel, E. I., 1931. Insects and Allied Pests of Plants Grown Under Glass, Mich. Agr. Expt. Sta. Spec. Bul. 214.

leaves, causing them to curl inwardly. The affected parts of the plants are stunted and crippled, flowers fail to mature, and buds may drop. Recovery from serious injury is very slow.

Control Experiments

The experiment reported here was carried on in a greenhouse during the winter of 1954. With one exception all of the insecticides used in the tests were systemic phosphates. The additional material, Isolan, is a carbamate.

Mature snapdragon plants used in the tests averaged 2.5 feet in height and were growing in 6-inch pots. There were three to six flower spikes per plant. The varieties of snapdragons were Pink Sensation and Copper King.

TABLE 8. CONTROL OF APHIDS ON SNAPDRAGON—TREATED FEBRUARY 19

Material & Dilution	No. Live Aphids on Plant	
	Feb. 26	April 13
Isolan 1-800	0	37
1-1600	0	0
1-3200	0	70
Systox 1-800	0	32
1-1600	0	7
12008 1-800	0	0
1-1600	0	0
12009 1-800	1	0
1-1600	17	19
12013 1-800	17	33
1-1600	86	17
Untreated	320[1]	1,000+[1]

[1] Counts from one flower spike only

On February 19, Isolan 25 per cent and Systox 50 per cent emulsions, in addition to the experimental dithiophosphates 12008, 12009 and 12013, all 50 per cent emulsions, were used as soil drenches in dosage series of 1 to 800 and 1 to 1600. Isolan was also used at a 1 to 3200 dilution. The treatments were made at the rate of 6 ounces of dilution per pot. The soils were moist when drenches were applied. All tests were replicated three times and randomized.

Examinations made on February 24 showed that the plants treated with Isolan, Systox, 12008 and 12009 at all dilutions were entirely free from aphid infestation. Aphids persisted, however, on the snapdragons to which 12013 had been applied, and were especially numerous at the 1 to 1600 dilution.

Aphid counts were made on February 26 and April 13 on all of the spikes on most of the plants (Table 8). The exceptions were one spike from the 4 untreated plants and one spike each from the plants treated with 12013 at both dilutions. In these cases, aphids were so numerous that it was not necessary to make counts on more than one spike.

Control of aphids on snapdragons with systemics used as soil drenches was successful (Table 8). The experimental dithiophosphates 12008 and 12009 gave the best results with the former holding a slight edge over the latter, especially noticeable at the 1 to 1600 dilution.

Isolan caused some burning of snapdragon foliage, most conspicuous at the 1 to 800 dilution. Many leaves showed burning, shriveling and blanching, which was confined to their tips and edges. This condition was entirely temporary. By early April all new growth on the Isolan-treated plants at all dilutions appeared to be free from any noticeable insecticide injury.

Figure 4. The European elm scale can cause serious damage to elm trees. The white rings around the scales are a waxy material secreted by the insect.

THE EUROPEAN ELM SCALE[1]

(*Glossyparia spuria* Mod.)

The European elm scale is a serious and destructive pest of elm species, several of which are numbered among the most popular of our ornamental trees. The pest has been in the United States for perhaps 70 years. Its introduction was accidental. It is reported to attack the American elm, cork elm, slippery elm, English elm, Camperdown elm and Scotch elm.[2] In the United States the insect is confined mostly to the American elm, probably

[1] Britton, W. E., 1911. Eleventh Rpt. State Ent., Conn. Agr. Expt. Sta. Bul. 344.
[2] List, G. M., 1920. The European Elm Scale, Colo. Agr. Expt. Sta. Circ. 29.

because this species is the one most generally grown. Furthermore, it seems to attack the American elms more vigorously than the introduced European species.

The insects may be first noticed as great numbers of elliptical or circular whitish rings (Figure 4) surrounding a darker center clustered along the underside of the limbs and branches and on the shaded sides of those growing in a somewhat vertical position. The white ring is made up of a waxy material secreted by the insect during its development. It curls inwardly and adheres firmly to the bark of the tree. The young are found clustered in crevices and cracks at the junction of twigs and branches and in depressions resulting from an injury or expansion. The scales are found on wood two or more years old and less frequently on one-year-old bark.

The insects live over winter in an immature condition. In 1954 egg laying and the appearance of young scales in the semi-cocoon of gravid females

TABLE 9. CONTROL OF EUROPEAN ELM SCALE

Date of Treatment	Dilution of Malathion	Scales on Twigs		Date Taken	Per Cent Kill
		Dead	Alive		
July 22	1-400	10	28	Aug. 20	26.3
	1-800	19	608		3.0
Aug. 26	1-100	224	0	Sept. 3	100.0
	1-200	31	1		96.8
		Scales on Leaves			
Aug. 26	1-100	118	0	Sept. 3	100.0
	1-200	40	0		100.0
Before Treatment		0	48	July 20	

was first observed on June 21. Dispersal of the crawlers to the bark and leaves takes place during the first 24 hours after hatching. By mid-July all or most of the eggs have hatched. There is only one generation a year.

Infested elm trees display a yellowing of the leaves on the lower branches during July. Later in the season seriously infested branches may become yellowish-brown. When the scales are extremely abundant, the foliage turns gray-green in color and wilts.

Control Experiments

Dormant sprays such as lime sulfur, kerosene emulsion, soap and water and scalecide have given a high degree of control of the pest.[1,2]

The experiment reported here, however, relates to the use of the phosphate insecticide malathion for control of the immature stages of the scale on city street trees.

Experiments were begun in mid-July when most of the young were out on the branches and leaves. Two 25 to 35-foot elm trees (*Ulmus americana*)

[1] Doten, S. B., 1908. The European Elm Scale, Nev. Agr. Expt. Sta. Bul. 65.
[2] Britton, W. E., and Zappe, M. P., 1927. Some Insect Pests of Nursery Stock in Conn., Conn. Agr. Expt. Sta. Bul. 292.

10 to 14 inches in diameter 40 inches from the ground were used. The trees were sprayed on July 22 with malathion in dosage series of 1 to 400 and 1 to 800; 40 to 50 gallons of spray were used per tree. Because of poor control by the first treatment (Table 9), the trees were resprayed on August 26 with malathion at 1 to 100 and 1 to 200. Control data were secured from ten 8 to 10-inch twigs taken at random from the treated trees. In view of the restricted number of trees in the experiment, none could be used as checks. This was allowed for by making counts of live scales on ten 10-inch twigs before the first series of spray treatments were made.

Results (Table 9) indicate that malathion at the strongest concentrations gave good control of European elm scale. Large quantities of spray material

Figure 5. The juniper scale is one of the most annoying pests of ornamental evergreens. Besides juniper, it attacks red cedar, arborvitae and cypress.

were necessary for adequate coverage of infested bark and assurance that the insecticide would reach young scales deeply imbedded in crevices and cracks.

THE JUNIPER SCALE

(Diaspis carueli Targ.)

The juniper scale (Figure 5), is one of the most annoying insect pests of ornamental evergreens. It occurs mostly on juniper, but has been reported on red cedar, arborvitae and cypress. It has increased and spread alarmingly in recent years. Badly infested plants appear sickly, yellowish or grayish in color, produce very little, if any, new growth, and soon turn brown, shrivel up and die in part or completely.

The scales live through the winter in an immature condition, some even approaching maturity. The adult form is attained in late April or early May in Connecticut. The female scale is circular in outline and at first snow-white in color, with a light yellow center. Later it may become dark grayish or almost black in appearance. The scales are convex and circular in outline, and about 1/16 to 1/20 of an inch in diameter.

Egg laying commences before the middle of May. In 1954, the first eggs were seen on May 12. The first young appear late in May or in early June (June 7, 1954). In 1954, 80 per cent of the eggs had hatched by June 23 and the young were dispersed over the foliage. There is only one generation a year.

Control Experiments

Parathion has been used effectively as a summer spray for control of this insect. Lime-sulfur appears to have given less adequate control. Summer oils have given best results in the spring, before growth begins.[1] Additional phosphate insecticides were used in the experiment discussed below.

TABLE 10. CONTROL OF JUNIPER SCALE—EXAMINED JULY 9

Material & Dilution	Scales	
	Dead	Alive
Malathion 1-400	191	0
1-800	312	8
12008 1-400	403	0
1-800	566	0
No. scales before treatment	0	1105

Two 4 to 5-foot juniper plants (*Juniperus commonis,* var. uncertain, perhaps *montana*) with 15 to 18-foot circumference were used in the experiment. They were divided in half. Malathion and experimental dithiophosphate compound 12008, both as 50 per cent emulsions, were used in dosage series of 1 to 400 and 1 to 800 on one-half a plant, respectively. The treatments were made on July 2. Data were obtained on July 9 from ten 1 to 2-inch twigs taken at random from the treated plants.

A check plant was not available. Counts before treatments were made, however, as indicated in Table 10. Two quarts of spray were used per treatment.

Results of the treatments indicate that the insecticides were effective in controlling immature juniper scales during early summer. The survival of scale crawlers may be accounted for by a lag in the hatch or by failure to hit the young with the spray. In any event, the several young that survived at the low dilution of malathion appear to be of minor importance. This could mean, however, that some reinfestation could be expected in the following year, unless a second treatment is made soon after the first.

[1] Neiswander, R. B., 1950. Insecticides for Juniper Scale. Ohio Farm & Home Research, Sept. & Oct.: 69-70.

HEMLOCK SCALE[1]

(*Aspidiotus* sp.)

In recent years a new species of scale insect, *Aspidiotus* sp. (Figure 6), closely related to *A. meyeri* Marl. described from China and *A. abietis* of Europe, has appeared on hemlock in Connecticut. It is not known exactly where the insect originated. It is a serious pest that appears to be rather widely scattered in the southwestern area of the State. Many valuable hemlocks used as ornamentals have been damaged by the pest. As a result some of the most seriously infested ones have been replaced with scale-free plants.

Figure 6. A new species in Connecticut, this scale has recently caused serious damage to hemlocks in the southwestern part of the State.

Many of the needles of badly infested trees are small in size, yellowish in color, with gray, brown or blanched-like areas. The vigor of a plant is impaired and when the infestation continues uncontrolled, needles may drop, and branches die.

Maturing scales survive the winter months. It was observed on May 3 that many of the male scales were ready to emerge. About 50 per cent of them had issued by May 18, and all were out and dispersed before the 28th. Eggs were found for the first time on June 8. Three of the 30 female scales examined contained one egg each. Examination made on June 15 showed that about 90 per cent of the scales contained eggs, none of which had hatched. By June 23 eggs were extremely abundant, and present under all

[1] Identified by Dr. Harold Morrison, U. S. Nat. Mus.

scales examined. Only a few had hatched. Several of the young were seen crawling on the needles. On July 2 numerous young scales were crawling on the new twigs. They were very small, flat and yellowish in color. They appeared to scatter over the needles and stems for a while before settling down to feed. As soon as they become stationary a white cottony covering begins to appear over the body. As the scales grow, the covering becomes denser, larger, cone-like in appearance and more conspicuous. Occasionally a young scale did not move, but established itself permanently under the parent scale.

At maturity the waxy scale covering the female is about 1/16 inch in diameter, somewhat circular in outline, and slightly elevated, with a nipple-like center. The female scales are dark gray or slate-like, with some almost black in color. The male scale is smaller, lighter in color and oval. Most of

TABLE 11. CONTROL OF HEMLOCK SCALE

Date of Treatment	Treatment & Dilution	Scales		Data Taken
		Dead	Alive	
July 2	Malathion 1-200	88	0	July 9
2	1-400	99	0	July 9
22	1-800	34	0	Aug. 6
July 2	12008 1-400	161	23	July 9
2	1-800	84	21	July 9
22	1-400	92	0	Aug. 6
22	1-800	60	0	Aug. 6
Counts before treatments		0	133	July 2

the scales were found on the twigs and the underside of the needles, with only a few on the upper surface. There appeared to be considerable overlapping of scales on heavily infested hemlocks.

Control Experiments

Nine 7 to 9-foot hemlocks were used in the experiment reported here. On July 2, two trees were sprayed with malathion 50 per cent emulsion at 1 to 200 and two at 1 to 400. Experimental compound 12008, 50 per cent emulsion, was used at the rate of 1 to 400 and 1 to 800 on two trees each. Because of the good control with malathion, the trees were not resprayed. An additional tree, however, was sprayed with malathion at 1 to 800 on July 22. On this date one-half of the trees sprayed with compound 12008 on July 2 were resprayed. Four to six quarts of spray were used per tree. A wheelbarrow mist-blower was used to apply the treatments. Control data were obtained from ten 2 to 4-inch twigs taken at random from the sprayed trees (Table 11).

One treatment of malathion at the stated dilutions gave good control of *Aspidiotus* scale (Table 11). Experimental dithiophosphate 12008 did not produce the same results except when the treatments were repeated. The insecticide formulations as used in the tests did not injure hemlock foliage.

THE SOFT BROWN SCALE

(*Coccus hesperidum* L.)

The soft brown scale is a common pest of greenhouse and house plants.[1] It attacks a number of plant species including ferns, palms and ivy. Seriously infested plants lose their thrifty, healthy appearance. The foliage becomes yellowish, brownish or grayish in color, and is frequently covered with a sticky material secreted by the scales. This material is known as honeydew, on which the sooty fungus grows, thus helping to make the plants more unsightly.

TABLE 12. CONTROL OF SOFT BROWN SCALE ON IVY—EXAMINED MAY 5

Treatment & Dilution	Av. No. of Leaves on Plant	No. of Scales[1]			
		1 Treatment		2 Treatments	
		Alive	Dead	Alive	Dead
Systox 1-400	34	85	0	12	25
1-800	11	68	20	12	5
1-1600	9	100	2	22	5
12008 1-400	3	0	21	0	7
1-800	4	0	4	0	5
1-1600	9	0	3	0	3
12009 1-400	8	23	1	0	11
1-800	5	0	1	0	3
1-1600	8	47	1	13	0
12013 1-400	6	69	0	135	3
1-800	32	150+	4	125+	2
1-1600	5	150+	4		
Untreated	9	154	4		

[1] Adults plus young.

Control Experiments on Ivy

On February 25, 1954, "Hans Self-Branching Evergreen Ivy" and "Variegated English Ivy" badly infested with soft brown scale, were treated with soil drenches of Systox, 50 per cent emulsion, and experimental dithiophosphate systemics 12008, 12009 and 12013, 50 per cent emulsions, in dosage series of 1 to 400, 1 to 800, and 1 to 1600. Each 2¼-inch pot received 2 ounces of solution. The soils were dampened before the treatments were made. Each pot was placed individually on ½-inch of sand in the bottom of 4½-inch 10-ounce glass dishes. This precaution was taken to prevent the spread of the treatments from pot to pot in the bench. The treatments were duplicated. Four plants were held as checks. One-half of the plants were retreated on March 25. Results of the treatments appear in Table 12.

Results indicate that two treatments of Systox and experimental dithiophosphate 12009 were needed to assure good control of soft brown

[1] Schread, J. C., 1954. Scale Insects and Their Control, Conn. Agr. Expt. Sta. Bul. 578.

scale on ivy. Compound 12008 produced excellent results with one treatment at all dilutions. On the other hand, compound 12013 failed to control the scales with one or two applications.

None of the treatments caused noticeable injury to either variety of ivy.

Control Experiments on Camellia and Avocado

On July 22, 1954, 3 to 4-foot camellia and avocado plants growing in 8-inch pots were treated with experimental dithiophosphate compound 12008 at 1 to 400 as a soil drench. Each pot received 1 quart of solution applied to moist soil. The treatments were not replicated. On August 12, the camellia was retreated but the avocado was not. Results of the treatments were taken on September 23. All of the scales were counted on 16 leaves taken at random from the avocado. Of a total of 9400 scales (mostly young), only 7 were alive. Twenty-five leaves taken from the camellia contained over 10,000 dead scales, almost all of which were immature. None was found alive.

The double treatment applied to camellia caused severe burning of the leaves and destroyed several flower buds. Although some phytotoxicity was evident on the avocado where only one treatment was used, the injury was much less serious than on the camellia.

SUMMARY

Several treatments of Isolan, malathion, BHC and compound 12009 did not produce lasting control of aphids on hawthorn. Longest control was obtained during April and after early July. Reinfestation during late May and June occurred repeatedly in trees sprayed with malathion and BHC, but less frequently in those treated with Isolan and 12009.

Viburnum aphids were controlled with malathion when treatments were applied between April 1 and 15. Spray applications made during the second half of the month killed the aphids but did not prevent curling of the leaves.

The pine bark aphid was controlled through the use of Isolan and malathion at high concentrations only.

Control of aphids on greenhouse snapdragons with systemics used as soil treatments proved successful. Isolan caused some burning of snapdragon leaves. The injured plants recovered quickly, however, and no permanent bad effects were seen.

Our experience with malathion would indicate that good control of aphids may be expected when a 50 per cent emulsion is used at the rate of 1 to 2 pints per 100 gallons of water, or 1 to 2 teaspoons per gallon. One or two treatments at 5 to 7-day intervals during early April should prevent serious curling of leaves of hawthorn and viburnum. On hawthorn, however, additional treatments will be required in late May and June to prevent reinfestation by aphids. A 25 per cent wettable powder used at the rate of 2 pounds per 100 gallons of water (2 to 3 teaspoons per gallon) may be substituted for the emulsion.

Pine bark aphid may be controlled with malathion at 3 to 4 times the above concentration. The treatment may be repeated if necessary. Systox used as a soil drench at the rate of ½ to 1 pint per 100 gallons of water or ½ to 1 teaspoon per gallon should check aphid infestation on snapdragons.

Malathion at high concentrations only gave good control of the European elm scale in mid-summer.

One treatment of both malathion and compound 12008 controlled the young of juniper scale.

The young of *Aspidiotus* scale on hemlock were controlled with one treatment of malathion. Compound 12008 did not give the same results except when the treatments were repeated.

Two soil treatments of Systox and experimental compound 12009 were required to obtain good control of soft brown scale on ivy. Compound 12008 gave excellent results with one treatment whereas compound 12013 failed to control the scale.

Soft brown scale on camellia and avocado was controlled with soil treatments of compound 12008.

Four pints of malathion emulsion per 100 gallons of water (4 teaspoons per gallon) applied about mid-August should give good control of European elm scale. (A 25 per cent wettable powder at 8 pounds per 100 gallons of water or 16 teaspoons per gallon may be substituted.) One-quarter the malathion dilution used to control European elm scale should give good control of juniper scale when treatment is made in early July. One-half the European elm scale treatment applied to *Aspidiotus* scale on hemlock in late July will give good results.

Soft brown scale on ivy may be controlled by using Systox emulsion at the rate of 1 pint per 100 gallons of water (1 teaspoon per gallon) applied to the soil twice at about 4-week intervals. Compound 12008 used in a similar manner should give comparable results in controlling the scale on camellia and avocado.